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Environment Surveys of Establishments: The Canadian Experience

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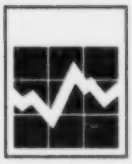

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Environment Accounts and Statistics Division

Environment Surveys of Establishments: The Canadian Experience

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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
p	preliminary
r	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
E	use with caution
F	too unreliable to be published

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Abstract

Since the mid-1990s, Statistics Canada has administered a number of environmental surveys designed to fill important data gaps and to improve our understanding of the links between economic actions and environmental change. Although significant experience has been gained in the collection of environmental statistics, the administration of environmental surveys continues to be challenging – from both a subject matter perspective and a methodological perspective. This paper will explore the development of the environment survey program at Statistics Canada, the framework within which the surveys exist and what data gaps the surveys fulfill. The paper will focus on Statistics Canada's experiences and challenges related to the recent development of a new environment survey on industrial water use and the methodological redesign of an existing survey on environmental protection expenditures and technology use in industry. The lessons learned serve as an input for future work related to the collection of environmental statistics.

Keywords: Environmental protection, environment surveys, methodology, environment statistics, water use.

Environment Surveys of Establishments: The Canadian Experience

by Jeff Fritzsche

1 Introduction

Statistics relevant to the environment have been collected at Statistics Canada for many years, although indirectly. However, since the mid-1970s, there has been some form of formal work devoted to the collection and dissemination of environmental statistics. It was not until the 1980s that more direct environmental questions appeared on business questionnaires. During the 1980s, growing environmental concerns manifested themselves in the development of the first dedicated environmental surveys in the late 1980s, beginning with the waste management industry.

The turning point for environmental statistics at Statistics Canada was Canada's Green Plan for a Healthy Environment that the Canadian federal government introduced in 1990. One aspect of this broad program was the improvement of Canada's accounting of the environment and natural resources. This infusion of resources over several years resulted in a renewed push to develop environmental statistics. Through this program, and others that subsequently replaced it, several new surveys were developed, including a survey of the 'environment industry', an environment survey of households and a survey of environmental protection expenditures made by business, all conducted within the Environment Accounts and Statistics Division.

2 Overview

The Environment Accounts and Statistics Division's primary mandate is to collect, develop, compile, analyze and publish environmental data in a variety of formats emphasizing their integration with socio-economic data. The division's objective is to provide users in government, business and the public at large with statistics that enable them to study the relationship between the environment and human activity.

One area of interest related to enviro-economic statistics has been business expenditures made to protect the environment. In fact, during the mid-1980s and into the 1990s, Statistics Canada collected some limited environment data related to capital and repairs expenditures for pollution abatement and control. These statistics supported collaborative work between Statistics Canada and Environment Canada in the preparation of the State of Environment Report for Canada and in the preparation of Statistics Canada's Human Activity and the Environment report. It was at this time that a new program of environmentally-orientated survey work building on Statistics Canada's traditional strengths of survey taking began. A pilot survey of Pollution Abatement and Control Expenditures was developed to provide more detailed information on environmental expenditures and technologies by industry.

A second driving force was the need for business data related to environmental protection expenditures in order to begin the construction of the Environmental Protection Expenditure Accounts – one of the components within the Canadian System of Environmental and Resource Accounts.[1]

During this time of expanding environmental statistics work at Statistics Canada, demand for environmental data was growing within policy departments. The Environment Industry Strategy in the mid-1990s provided funding to develop and implement a survey of the environment industry. At the sunset of the Greenplan, GAP II funding was

1. Statistics Canada, December 1997. *Econnections: Linking the Environment and the Economy. Concepts, Sources and Methods of the Canadian System of Environmental and Resource Account*, catalogue no. 16-505-G, Ottawa.

secured through the Policy Research Data Group, enabling the continuation of the environment business surveys, among other projects.

More recently, in 2003, the National Round Table for the Environment and the Economy recommended the development of six national environmental indicators. The Federal government announced in the February 2004 Speech from the Throne, a commitment to develop a set of national indicators on air quality, water quality and greenhouse gas emissions. In 2005/06, Statistics Canada, in partnership with Environment Canada and Health Canada, received funding for the development of a national set of environmental indicators.

Statistics Canada's role is to provide statistical advice, to publish the annual Canadian Environmental Sustainability Indicator reports jointly with Environment Canada and to provide context to monitoring data through a variety of means, including a portfolio of surveys.

In order to support the development of the water quality indicator, a portfolio of surveys was deemed necessary to examine the major water use sectors: municipal, agricultural and one of the subjects of this paper, industrial. Statistics Canada began administering a series of industrial water use surveys for Environment Canada in 1972. The survey took place approximately every five years coordinated with the Census of Canada until the last survey done for the 1996 reference year. Given that this survey had not been administered in 10 years, it was decided to revive the survey to fill an important data gap.

3 Business environmental protection expenditures

3.1 Background

Beginning in 1985, Statistics Canada began collecting annual statistics on pollution abatement and control capital expenditures made by the business sector through the Capital Repairs and Expenditures Survey (CRES). The information collected was limited to pollution abatement and control capital expenditures on non-residential construction and machinery and equipment, as a percentage of total expenditures.

Growing demand for more detailed statistics on environmental protection expenditures led to the development of a pilot "Pollution Abatement and Control Survey 1989" that was put in the field in 1990. The survey was the first comprehensive survey conducted by Statistics Canada on this matter and was sent to a sub-sample of business that received the CRES in forestry, mining, manufacturing, utilities, trade, financial, commercial, institutions and government sectors.

A second, much revised survey was not conducted until the 1994 reference year. The Survey of Environmental Protection Expenditures (SEPE) was conducted annually until the 1998 reference year, when it became a biennial survey.

3.2 What is measured?

The 1989 Pollution Abatement and Control Survey collected statistics on capital and operating expenditures on pollution abatement and control (PAC).[2] The questionnaire was progressive in its content. For example, it contained questions on sales of own use of pollution abatement and control-recovered materials. These questions were designed to measure cost savings and revenues derived from pollution abatement activities and recovered materials.

In addition, the questionnaire included questions on the resulting reductions in emissions to various media as a consequence of PAC and 'change in processes'[3] investments. The respondent was asked to list the major substance(s) and the reduction in the emissions of the substance(s) in tonnes for air, water, contained liquid wastes and solid wastes. The objective was to calculate the impact of investments in construction and machinery and equipment on physical emissions. However, the collection of physical emission statistics was very challenging for

2. Pollution abatement and control (end-of-pipe processes) can be described as equipment and processes that treat pollution and wastes after they have been created.
3. 'Change in process' was the precursor to the concept of 'pollution prevention'.

the respondents, as businesses used many different units of measure for a wide variety of substances emitted. In addition, many respondents could not provide the information while those that did respond provided at times very precise information while others provided information for very broad categories.

The 1989 survey also deliberately restricted questions to include only capital and operating expenditures on pollution abatement and control to retrofit facilities and equipment installed exclusively for PAC purposes. The objective was to focus on clear 'end-of-pipe' and other identifiable PAC investment, rather than expenditures on 'changes in processing techniques'. Additionally, the installation of new production equipment was excluded, since these expenditures are often made for a number of reasons, such as capacity expansion, replacement and modernization and pollution abatement and control.

3.3 The need to define 'environmental protection expenditures'

The 1989 pilot survey provided Statistics Canada with some valuable lessons related to the challenges of collecting environmental protection statistics. One challenge was the importance of providing respondents with a clear definition of 'environmental protection expenditures'. By simply asking the respondent to include only those expenditures made solely for protection of the environment, the interpretation is left to the judgment of the respondent. This is acceptable depending on the objectives of the survey. However, providing the respondent with some direction is crucial to minimize the likelihood of subjective responses that are difficult to explain analytically. For example, one business may install new, more efficient machinery and equipment to reduce pollutant emissions that also increase productivity, and may therefore include the expenditure on the survey. Another company installing the same equipment may interpret the investment as one made to reduce production costs and improve productivity, while also reducing pollutant emissions, and may therefore not include the expenditure on the survey.

The importance of defining environmental protection expenditures has become even more crucial as industry has moved from more traditional end-of-pipe solutions to integrated processes (pollution prevention) and technologies. Expenditures made on a scrubber at the end of an emissions stack or a bin used to collect and store hazardous solid wastes are clearly identifiable as expenditures on environmental protection. However, integrated processes can be much more difficult to separate out from the overall production process.

Beginning with the 1994 reference year survey, the decision was made to use a more restrictive definition of environmental protection expenditures on the survey questionnaire. Instead of using a 'pure purpose criterion'[4] that relied on the respondent to only include expenditures made for the sole purpose of protecting the environment, the more restrictive 'compliance criterion' was adopted. This criterion is defined in the 2003 System of Integrated Environmental and Economic Accounting handbook as "Expenditure undertaken with the main objective of protecting the environment but specifically in order to comply with environmental protection legislation, conventions and voluntary agreements. This can be further sub-divided to show those activities and transactions undertaken in order to comply with legislation only."[5]

Respondents to the survey are also asked to include those expenditures made in anticipation of an environmental regulation, convention or voluntary agreement. This inclusion is made in order to capture environmental protection investments made by businesses in anticipation of the regulation or agreement coming into effect at a point in the future.

3.4 Challenges in the application of the definition

Despite the effort to provide some context for respondents in terms of what 'environmental protection expenditures' are, it remains challenging for respondents to separate out the environmental from the non-environmental expenditure for a variety of reasons. For example, many businesses simply do not have the accounting systems

4 The 'pure purpose criterion' is defined in the *Integrated Environmental and Economic Accounting 2003* handbook as "Activities and expenditure where the main objective is protecting the environment are included in full. This criterion works best where the main objective of protecting the environment is clear and unambiguous, for example end-of-pipe capital expenditure."

5 United Nations. 2003. *Integrated Environmental and Economic Accounting Handbook, 2003*. p. 5-6.

in place to track environmental protection costs, nor can they always distinguish within a complex production process what should be included in their estimates and what should not. In addition, the SEPE questionnaire asks for expenditures based on categories of activities, rather than specific technologies or services. For example, the SEPE questionnaire includes the activity of environmental monitoring, pollution prevention (P2)[6] and end-of-pipe processes. Some respondents may have difficulty separating out their monitoring costs from their integrated processes or end-of-pipe activities.

Businesses will also engage in expenditures that are 'beyond compliance'. These are expenditures made by businesses that result in reductions in emissions beyond what the environmental regulation, convention or voluntary agreement calls for. Although out of scope for the SEPE, these expenditures could be substantial. It is also probable that some businesses include those costs in their reported values, thereby over-estimating expenditures for the purposes of the SEPE. This issue will need to be addressed in the future. Businesses may also report expenditures that have environmental benefits but were not made to comply with environmental regulation, convention or voluntary agreement or the expenditures simply cannot be separated out.

During the development of the 1994 SEPE questionnaire, questions related to physical emissions were removed. This decision was based on the difficulty respondents had at the time in estimating the impact of their PAC and P2 investments on emissions to various media. Subsequent survey questionnaires have been restricted to financial and other descriptive variables.

3.5 Expansion into service areas

In 2006, Environment Accounts and Statistics Division began a joint project with Services Division to expand collection of environment-related statistics in the services sector. During the consultations, it was concluded that the addition of one or two questions on waste management expenditures would be most feasible over the short term, given that all businesses have to deal with the waste they produce.

The General Index of Financial Information database, otherwise known as the GIFI, was used to help identify potential NAICS[7] service industries that reported larger waste removal expenses. This database is a census of corporate financial statements available from the Canada Revenue Agency (CRA).[8] The analysis of GIFI data for businesses in service industries revealed that a small number of industry groups reported the majority of waste management expenses. However, it was also found that only 1% of enterprises provided a waste management expense,[9] representing approximately 9,000 firms out of a total universe of 900,000 service firms found in the database.

During the analysis, it was determined that NAICS 531 (Real Estate) and 722 (Food Services and Drinking Places) represented approximately 40% of all reported GIFI waste expenses. Other important industries according to GIFI included: NAICS 562 (Waste Management and Remediation Services), already covered by EASD surveys; NAICS 8139, Business, Professional, Labour and Other Membership Organizations, but more specifically NAICS 81399, Other Membership Organisations. This industry includes tenant and condo associations and accounted for 8% of waste expenses but is not surveyed by Services Division.

Services Division concluded that an accurate measure of waste management expenses can not be obtained from GIFI data since these expenses are being reported within other expense categories, such as repair and maintenance and other expenses etc. Since the GIFI results indicated that NAICS 531 and 722 had the largest shares of waste management expenses and these industries were already being surveyed by Services Division, it was decided to include more detailed questions on waste management on two surveys: 2006 Survey of Service Industries: Real Estate Rental and Leasing and Property Management and 2006 Survey of Service Industries: Food Services and Drinking Places.

6. Pollution prevention is technologies, equipment or processes that reduce or eliminate pollution *before* they are created.
7. NAICS refers to the North American Industry Classification System jointly developed by the US, Canada, and Mexico to categorize business activities in a comparable manner across the three countries. NAICS has replaced the old Standard Industry Classification (SIC) codes.
8. Statistics Canada. April 2005. GIFI *Guide*. Ottawa, Ontario.
9. Canadian businesses are not required to split out their waste management expenses when reporting to the Canadian Revenue Agency.

Results from the surveys will be used to help verify whether administrative data such as GIFI can be used to estimate environment-related protection expenditures for other service industries in the future.

In 2002, Agriculture Division began collecting statistics related to capital investments by farmers in Canada for environmental protection improvements related to shelterbelts, windbreaks, buffer strips or fences for waterways protection.[10]

3.6 Redesign

At the conclusion of the 2004 reference year survey cycle, an opportunity to redesign the Survey of Environmental Protection Expenditures presented itself. The growth in the length of the survey and scope of the environment survey program within the Environment Accounts and Statistics Division made it increasingly difficult to manage all aspects of the survey process in-house - with the exception of data collection that was contracted out to experts in the Operations and Integration Division. In addition, with the revival of the Industrial Water Survey (IWS), there was an opportunity to take advantage of the methodological systems and experience being put in place for that survey in the SEPE redesign.

As the IWS blazed a trail for the SEPE to follow, business survey methodologists in Business Survey Methods Division continued to develop expertise in designing the methodological aspects of environment surveys. The SEPE redesign would follow the IWS lead and introduce significant changes.

Previously, the frame for the survey sample was built by the survey section in EASD, from various sources, such as the Annual Survey of Manufacturers and the Census of Mines. For the 2006 reference year, the survey has moved to a centralized frame (central business register[11]) enabling the selection of all units from one centralized base, used by many other business survey divisions. Statistics Canada's business register (BR) also permits each survey to have a customized collection entity, allowing EASD to match any units selected in the new sample to the previous SEPE contact data to retain that important information where possible. Frequently, it is the employee with knowledge of the environmental protection activities that completes the questionnaire. The remaining unmatched establishments were subsequently matched to the IWS data file since the contact person for that survey would likely have knowledge of environmental practices at the establishment. Finally, any remaining non-matched records were matched to other business surveys to populate the contact and establishment address fields.

The sampling methodology used by the SEPE in previous years was based on a non-random sampling approach where industries were stratified into take-all and take-some portions ranked by employment size. With the exception of the Territories and Prince Edward Island where the employee cut-off was 20, establishments had to have 50 or more employees to be in sample. All establishments with 50 or more employees were selected in the take-all strata, and the largest top 15% or 20% of establishments based on employment size were selected in the take-some strata.

The new probabilistic sampling methodology takes into account the challenge of surveying primary and manufacturing industries by essentially splitting the survey into two parts. The first part is a census of enterprises with 20 or more employees in the Oil and Gas Extraction and Pipeline Transportation industries. Sampling at the enterprise level allowed EASD to customize the collection units to suit the unique structure of these industries. The second survey group contains the remaining industries in the primary and manufacturing industries. The sampling unit was the establishment stratified based on revenue. The take all stratum includes the very large establishments, the second take-some stratum contains medium sized establishments while the third take-some stratum contains the smaller establishments. A light sampling of establishments with 20 to 50 employees in all industries was done for the first time.

The method used to determine the boundaries of the strata was the Lavallée-Hidiroglou (L-H) algorithm (1988) using the generalized system StatMx. The Generalized Sampling System (GSAM) was used to select the sample.

10. Statistics on capital expenditures by farmers for environmental improvements are collected on the Farm Financial Survey.
11. Statistics Canada's Business Register is a central repository containing principal statistics on all businesses in Canada.

A new edit and imputation (E&I) system will be developed for the SEPE using the Generalized Edit and Imputation System (GEISS), borrowing from the structure developed for the IWS. BSMD and EASD will work together on the E&I system, thoroughly reviewing the FoxPro-based system used in the past to produce the estimates. The new system will take advantage of the approach and experience gained from administering the previous system, and from lessons learned in administrating the IWS.

Applying the weights to the questionnaire cells and table production will also use Statistics Canada's generalized systems. The automated system will provide several advantages as compared to the previous FoxPro-based estimation programs; the largest being much improved timeliness, given that the table production process can be run without the need for expertise in FoxPro.

The development of customized confidentiality programs for the IWS using Statistics Canada's generalized systems provided BSMD with some background and expertise that will be useful when the SEPE programs are developed. The system also allows for two and three dimensional confidentiality testing resulting in more a more robust and secure system to ensure data is non-confidential.

The decision was also made to discontinue the use of the short and long questionnaire sampling strategy and go with one (detailed) questionnaire sent to all respondents. The 2006 reference year questionnaire was reorganized and improved where possible. All respondents will receive the more detailed questionnaire, resulting in some response burden increase for the industry sample that used to get the shorter questionnaire. However, it will result in improved comparability between industry groups and more complete results.

3.7 Challenges

One of the biggest challenges when designing the edit and imputation system has been finding relationships between the environmental variables collected on the questionnaire and economic variables collected by other economic surveys at Statistics Canada. For standard economic estimation or edit and imputation, the approach will be to use standard variables such as total value of shipments, total assets or total revenues to help estimate the non-response or the non-surveyed population, for example. However, these standard economic variables do not correlate consistently with environmental protection expenditure levels. This can be challenging for methodologists when designing edits and imputation formulas based on donor information for the establishment or similar establishments collected on other surveys.

There are numerous internationally-recognized classification systems available to statistical agencies to assist in the collection and dissemination of economic information from businesses. For example, Statistics Canada uses the North American Industrial Classification System to classify every business in Canada into their respective industry. There are also product classifications such as the Standard Classification of Goods or North American Product Classification System. However, there are no standard classifications for environmental technologies or processes for use by Statistics Canada which poses challenges in terms of the ability to use other data sources, such as other business survey or administrative data, for example. This lack of classification detail necessitates the administration of a dedicated survey to collect the environmental information.

There are various other challenges related to the collection of environmental statistics from businesses. For example, businesses have difficulty separating out their environmental protection expenditures from other types of expenditures, particularly for integrated technologies and operating expenses, mainly because their accounting systems do not track them. Also, businesses, particularly the small and medium-sized, may not be as familiar with concepts such as pollution prevention, pollution abatement and control or climate change.

The Survey of Environmental Protection Expenditures includes instructions for each question on the questionnaire but also points the respondent to the users guide at the end of the questionnaire for additional information and explanation as needed. The survey also includes a question asking respondents to provide a brief explanation to account for significant changes in environmental protection expenditures made by the establishment (increases or decreases) in order to help Statistics Canada reduce the need for follow-up inquiries.

Since the 1995 reference year survey, an electronic version of the questionnaire was available to respondents who requested it in Microsoft Excel format. Over time, the electronic questionnaire received modest improvements while growing in popularity with respondents. However, distributing the Excel spreadsheet questionnaire was time consuming for the collection team. For the 2006 reference year, a fillable Adobe Acrobat PDF questionnaire has been developed. The questionnaire is virtually identical to the paper questionnaire, includes simple edits and data verification and allows the respondent to save a copy of the PDF with their data. This tool has been developed as a respondent aid but is not a true electronic data reporting system.

4 Industrial Water Survey

Under the authority of the Statistics Act, Statistics Canada conducted the Industrial Water Survey (IWS) for Environment Canada annually from 1972 to 1976 and every five years until 1996. Various industries were surveyed over the 20 year period. The final survey done in the series, in 1996, was sent to the manufacturing, mineral extraction and thermal power generation sectors.

The purpose of the survey was to gather information on intake volumes, discharge volumes, how the water was used and types of treatment done on the water. Cost information associated with use, discharge and treatment was also collected. Over the 25 year period of collection, the content of the questionnaires remained relatively constant.[12] The main purpose of the survey was not only to collect information on water use but also to collect basic information on water prices.

The Canadian federal government's decision to develop a set of national indicators on air quality, greenhouse gas emissions and water quality was the catalyst to revive a survey of industrial water use and quality, among other initiatives. The survey is part of a portfolio of surveys to be used to examine the major water use sectors: industrial, agricultural and municipal. The industrial survey was the first to go into the field for the 2005 reference year, while the agricultural water use survey is in the testing phase and municipal water survey is in the research and development phase as of this writing.

4.1 Background and survey development

Statistics Canada, Environment Canada and Health Canada worked cooperatively to review and update the 1996 water use surveys. The decision was made early on to develop the new survey to maximize comparability with the 1996 edition. The questions were reviewed by subject matter experts at Environment Canada and other government departments and the original questionnaire was reviewed by various industry associations.

In addition to content similar to the 1996 survey, the decision was also made to survey the same industrial sectors as had been done in the past. The core sets of questions were retained from the 1996 edition: water intake, discharge and treatment and cost information associated with those three main activities. Three draft questionnaires were developed that collected the core information but included some unique customization for each of the following sectors: thermal, fossil-fuel and nuclear electric power generating plants; manufacturing establishments; and the mineral extraction industry. Once the draft questionnaires were completed, Statistics Canada tested the questionnaires in various cities across Canada. These one-on-one interview sessions with potential respondents in the three sectors were designed to gather feedback on various aspects of the survey questionnaires. For example, were they able to understand the questions? Was it difficult for the respondent to provide the data being requested? Did the questions make sense for their industry and were there any questions not on the questionnaire that should be? The information gathered from both the data users and the data suppliers was used to develop the final questionnaires.

A second objective was to develop a sound methodological framework from sample selection through to the final estimates. The revised Industrial Water Survey would be the first current dedicated environment business survey to

12. D.N. Sharf. 2001. *Technical Manual for the 1996 Industrial Water Use and Pricing Surveys, 1972-1996*. Environmental Economics Branch, Environment Canada, Ottawa, Ontario.

use methodological support from the Business Survey Methods Division, and be linked to Statistics Canada's central Business Register. The survey will also make use of several of the generalized systems developed at Statistics Canada for edit and imputation, outlier detection, weighting, table production and confidentiality assurance.

4.1.1 What is measured

The objective of the 2005 IWS was to collect detailed statistics on water use and management, as well as collecting some basic indicators of water quality. A second objective was to update the survey while maximizing comparability with the 1996 survey.

The decision to use three survey questionnaires was retained and the questionnaires were finalized for the three industry sectors. All three questionnaires retained the core set of questions, with some customization to reflect the unique characteristics of each industry group. However, common information was collected for all three sectors, including:

- Water intake by source, water treatment, purpose and recirculation/reuse
- Water discharge, including type of treatment prior to discharge and point of discharge
- Operating and maintenance costs for water acquisition, treatment of intake water, treatment of discharge water
- Capital expenditures on water intake, discharge and treatment facilities

4.1.2 Sampling

In June 2006, the three survey questionnaires were sent to 6,800 respondents across the three industry sectors. Results will be released in summer 2007. There were several challenges and lessons learned, particularly since it had been ten years since a similar survey had been conducted.

Data users were interested in producing statistics by environmental geographies as well as traditional industry and province, in particular watershed basins. The current central Business Register did not include these types of stratification variables. Using geographical information systems, the watershed basin codes were added to the survey universe file using postal code information. Challenges included postal codes that were miscoded on the BR or mismatches between the watershed geographic file and the establishments on the survey universe file.

There were challenges in designing the sample, particularly given the lack of current data on water use. With the exception of the thermal power generating plants where a census was taken considering the small size of the population, the mineral extraction and manufacturing establishments were selected using a stratified simple sample design. The Lavallée-Hidiroglou algorithm was used to determine the sample size, the stratification and the allocation of the sample using a size measure[13] as the auxiliary variable. The selection of the sample for the Mineral Extraction and Manufacturing components was achieved using GSAM. The sampling design did not have the benefit of more recent historical data on water use to help stratify the sample further. Since there was no historical information to help identify the heavier water users, a broad sampling strategy was used that included all manufacturing industries in the population.

'Specialized' surveys such as those that deal with environment-related themes, such as environmental protection expenditures, or water use and costs are often not filled out by the same individuals in a company that fill out the more standard economic surveys received by Statistics Canada. This can make it difficult to find the appropriate individual within an establishment to complete the survey. The Business Register generally has contact information related to the financial officer or comptroller of a company, while the IWS would more likely be filled out by the environment manager or perhaps an environmental engineer, particularly in larger companies. The mail file for the IWS was matched to contact information collected by the SEPE and some pre-contact was done before the IWS survey was mailed out in order to try and find the most appropriate contact person in the establishment. However,

13. In order to properly stratify the population into size groups, a size measure was created. Shipment values were used from the Annual Survey of Manufacturers 2003 wherever possible, followed by a modeled shipment value and finally Gross Business Income if the other variables were not available.

there were still many cases where the appropriate contact person was not known at the time of mail out. The result in some cases was delayed responses and likely a contribution to a lower response rate.

4.2 Challenges and lessons learned

The sampling strategy for the manufacturing component was too broad and will need to be refined. The results from the 2005 survey will help to develop a more defined cut-off strategy and a redefinition of the "lightly sampled" stratum in order to minimize number of insignificant records selected. The results will also assist in the refinement and improvement of the E&I and estimation systems.

During collection, analysis of questionnaire responses revealed some large discrepancies in water use data submitted by respondents in the same industry group, such as pulp and paper establishments, smelters and refineries. For example, there were pulp and paper establishments indicating they used much more water than other pulp and paper establishments with similar characteristics. However, at the establishment level, some pulp and paper plants were including water use in the generation of on-site electricity. If some establishments are including this water use, while others are not or do not have such facilities, difficulties arise when trying to determine whether these establishments should be included in the edit, imputation and estimation process. It may be necessary to sample at the location level, in order to try and eliminated these types of discrepancies in the collection process.

Frequently, individual records that were reviewed by subject matter revealed that the respondent reported values but used the wrong unit of measure. Determining whether or not thousands of cubic meters were reported or whether the respondent reported in cubic meters was difficult, despite a section at the beginning of the questionnaire that asked to respondent to indicate the unit of measure. Verification of these types of discrepancies was very difficult given the lack of historical information and the unique subject matter.

4.2.1 Difficulties respondents experienced

Respondents had difficulty providing the detailed financial data requested. The information was not readily available, causing some respondents to give non-responses or to give 'best guess' estimates. In addition, water intake and discharge volume information was often not available. For many industries in many jurisdictions, there is no requirement to monitor water intake or discharge. Often, water costs are included in the lease of buildings, resulting in no incentive to monitor the use. On the other hand, some industries are required to treat all water leaving their property, including rain and snow melt volumes. The accuracy of measurement of these volumes is often in doubt. To accommodate the lack of precise measurement, some establishments would estimate (from pump curves, for example).

The rationale for some of the questions in the survey was not always clear to respondents, causing some resistance to providing the information. In addition, the respondents did not always understand the instructions and definitions provided, resulting in some confusion as to what was being asked. An improved reporting guide is being developed to provide further assistance to respondents.

Finally, comments by respondents indicated a significant demand for electronic reporting. In fact, one industry association developed a Microsoft Excel spreadsheet of the questionnaire for their membership. The development of the fillable Adobe PDF for the IWS survey is likely should the SEPE version prove successful.

5 Conclusions

5.1 On the one hand,

A lack of standard classifications limit the options for data compilation and comparability while the central business register does not include 'environmental' variables such as drainage basin or eco region codes for sample selection and stratification. Respondents have difficulty providing estimates of their environmental protection expenditures

or water use and discharge, particularly where no metering exists. Collecting both physical and financial data on the same form can cause delays and increased response burden and follow-up since more than one person in a company will likely have to provide the information. The challenge remains methodologically to design imputation and estimation systems for missing environmental variables, non-response questionnaires and the non-surveyed portion of the population.

5.2 On the other hand,

Despite the challenges facing industries such as manufacturing in Canada, businesses are often keen to report their effort to protect the environment, as reflected by response rates in the high seventies and low eighty percent range. Growing awareness of environmental issues may also manifest themselves in a businesses' understanding of environmental concepts such as pollution prevention and climate change. In fact, some respondents have indicated that they have modified their accounting systems to better track their environmental protection expenditures. The business survey 'infrastructure' at Statistics Canada continues to develop the tools needed by administrators of environmental surveys, including methodological expertise.

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